

REFERENCES

- Arguelles, T., and Guardiola, J. L. (1977). Hormonal control of senescence in excised orange leaves. *J. Hortic. Sci.* **52**, 199–204.
- Bernard, R. L., and Weiss, M. G. (1973). Qualitative genetics. In "Soybeans: Improvements, Production and Uses" (B. E. Caldwell, ed.), pp. 117–154. Am. Soc. Agron., Madison, Wisconsin.
- Bewley, J. D., and Black, M. (1985). "Seeds. Physiology of Development and Germination." Plenum, New York.
- Bose, B., and Srivastava, H. S. (1979). Role of nitrate in delaying senescence of detached leaves. *Indian J. Exp. Biol.* **17**, 932–934.
- Butler, R. D. (1967). The fine structure of senescing cotyledons of cucumber. *J. Exp. Bot.* **18**, 535–543.
- Chen, Y. M. (1972). Certain aspects of light and plant hormones in control of senescence. *Taiwania* **17**, 81–91.
- Choe, H. T., and Thimann, K. V. (1975). The metabolism of oat leaves during senescence. III. The senescence of isolated chloroplasts. *Plant Physiol.* **55**, 828–834.
- Crafts-Brandner, S. J., and Poneleit, C. G. (1987). Effect of ear removal on CO₂ exchange and activities of ribulose biphosphate carboxylase/oxygenase and phosphoenolpyruvate carboxylase of maize hybrids and inbred lines. *Plant Physiol.* **84**, 261–265.
- Crafts-Brandner, S. J., Below, F. E., Harper, J. E., and Hageman, R. H. (1984). Differential senescence of maize hybrids following ear removal. I. Whole plant. *Plant Physiol.* **74**, 360–367.
- Crocker, W. (1939). Ageing in plants. In "Problems of Ageing" (E. V. Cowdry, ed.), 1st Ed., pp. 1–31. Williams & Wilkins, Baltimore, Maryland.
- Davies, I., and Sigee, D. C. (1984). Cell ageing and cell death: perspectives. In "Cell Ageing and Cell Death" (I. Davies and D. C. Sigee, eds.), pp. 347–350. Cambridge Univ. Press, London and New York.
- Dedolph, R. R., Wittwer, S. A., and Tuli, W. (1961). Senescence inhibition and respiration. *Science* **134**, 1075.
- De Luca d'Oro, G. M., and Trippi, V. S. (1982). Regulación de clorofilas y proteínas solubles por cinetina y cicloheximida, en condiciones de luz y oscuridad, durante la senescencia foilar en *Phaseolus vulgaris* L. *Phyton (Buenos Aires)* **42**, 73–82.
- Derman, B. D., Rupp, D. C., and Noodén, L. D. (1978). Mineral distribution in relation to fruit development and monocarpic senescence in Anoka soybeans. *Am. J. Bot.* **65**, 205–213.
- De Vecchi, L. (1971). Fine structure of detached oat leaves senescing under different experimental conditions. *Isr. J. Bot.* **20**, 169–183.
- Dilley, D. R., and Carpenter, W. J. (1975). The role of chemical adjuvants and ethylene synthesis on cut flower longevity. *Acta Hortic.* **41**, 117–132.
- Duncan, R. R., Bockholt, A. J., and Miller, F. R. (1981). Descriptive comparison of senescent and nonsenescent sorghum genotypes. *Agron. J.* **73**, 849–853.
- Eilam, Y. (1965). Permeability changes in senescing tissue. *J. Exp. Bot.* **16**, 614–627.
- Elbert, V. F., and Elbert, G. A. (1975). "Fun with Growing Odd and Curious House Plants." Crown, New York.
- Engelbrecht, L., and Nogai, K. (1964). Zur Frage der Kinetinwirkung gegenüber der Stoffwechselhemmung durch Chloramphenikol. *Flora (Jena)* **154**, 267–278.
- Feller, U. (1979). Effect of changed source/sink relations on proteolytic activity and on nitrogen mobilization in field-grown wheat (*Triticum aestivum* L.). *Plant Cell Physiol.* **20**, 1577–1583.

- Fridovich, I. (1978). The biology of oxygen radicals. *Science* **201**, 875–880.
- Gaff, D., and Okong'o-Ogola, O. (1971). The use of non-permeating pigments for testing the survival of cells. *J. Exp. Bot.* **22**, 756–758.
- Goldschmidt, E. E. (1980). Pigment changes associated with fruit maturation and their control. In "Senescence in Plants" (K. V. Thimann, ed.), pp. 207–217. CRC Press, Boca Raton, Florida.
- Goldthwaite, J. J. (1974). Energy metabolism of *Rumex* leaf tissue in the presence of senescence-regulating hormones and sucrose. *Plant Physiol.* **54**, 399–403.
- Goldthwaite, J. J., and Laetsch, W. M. (1967). Regulation of senescence in bean leaf discs by light and chemical growth regulators. *Plant Physiol.* **42**, 1757–1762.
- Halevy, A. H., and Mayak, S. (1979). Senescence and postharvest physiology of cut flowers, part 1. *Hortic. Rev.* **1**, 204–236.
- Halevy, A. H., Mayak, S., Tirosh, T., Spiegelstein, H., and Kofranek, A. M. (1974). Opposing effects of abscisic acid on senescence of rose flowers. *Plant Cell Physiol.* **15**, 813–821.
- Halliwell, B., and Gutteridge, J. M. C. (1985). "Free Radicals in Biology and Medicine." Oxford Univ. Press, London and New York.
- Hardwick, R. C. (1979). Leaf abscission in varieties of *Phaseolus vulgaris* and *Glycine max*: A correlation with propensity to produce adventitious roots. *J. Exp. Bot.* **30**, 795–804.
- Hart, R. W., and Turturro, A. (1985). Review of recent biological research on theories of aging. *Rev. Biol. Res. Aging* **2**, 3–12.
- Kahanak, G. M., Okatan, Y., Rupp, D. C., and Noodén, L. D. (1978). Hormonal and genetic alteration of monocarpic senescence in soybeans. *Plant Physiol.* **61**, Suppl., 26.
- Kao, C. M. (1978). Senescence of rice leaves. II. Antisenescence action of cytokinins. *Proc. Natl. Sci. Counc. Repub. China* **2**, 391–398.
- Knypl, J. S. (1970). Arrest of yellowing in senescing leaf discs of maize by growth retardants, coumarin and inhibitors of RNA and protein synthesis. *Biol. Plant.* **12**, 199–207.
- Knypl, J. S., and Mazurczyk, W. (1971). Arrest of chlorophyll and protein breakdown in senescing leaf discs of kale by cycloheximide and vanillin. *Curr. Sci.* **40**, 294–295.
- Krueger, A. P., and Reed, E. J. (1976). Biological impact of small air ions. *Science* **193**, 1209–1213.
- Krul, W. R. (1974). Nucleic acid and protein metabolism in senescing and regenerating soybean cotyledons. *Plant Physiol.* **54**, 36–40.
- Lamont, B. B. (1980). Tissue longevity of the aborescent monocotyledon *Kingia australis* (Xanthorrhoeaceae). *Am. J. Bot.* **67**, 1262–1264.
- Legocka, J., and Szweykowska, A. (1981). The role of cytokinins in the development and metabolism of barley leaves III. The effect on the RNA metabolism in various cell compartments during senescence. *Z. Pflanzenphysiol.* **102**, 363–374.
- Legocka, J., and Szweykowska, A. (1983). The role of cytokinins in the development and metabolism of barley leaves. VI. The effect on the protein metabolism in various cell compartments during leaf senescence. *Acta Physiol. Plant* **5**, 11–20.
- Lewington, R. J., and Simon, E. W. (1969). The effect of light on the senescence of detached cucumber cotyledons. *J. Exp. Bot.* **20**, 138–144.
- MacDougal, D. T., and Long, F. L. (1927). Characters of cells attaining great age. *Am. Nat.* **61**, 385–406.
- McGlasson, W. B., Wade, N. L., and Adato, I. (1978). Phytohormones and fruit ripening. In "Phytohormones and Related Compounds: A Comprehensive Treatise" (D. S. Letham, P. B. Goodwin, and T. J. V. Higgins, eds.), Vol. 2, pp. 447–493. Elsevier/North-Holland, Amsterdam.
- Makovetzki, S., and Goldschmidt, E. E. (1976). A requirement for cytoplasmic protein synthe-

- sis during chloroplast senescence in the aquatic plant *Anacharis canadensis*. *Plant Cell Physiol.* **17**, 859–862.
- Martin, C., and Thimann, K. V. (1972). The role of protein synthesis in the senescence of leaves. I: The formation of protease. *Plant Physiol.* **49**, 64–71.
- Matile, P., and Winklenbach, F. (1971). Function of lysosomes and lysosomal enzymes in senescing corolla of the morning glory (*Ipomoea purpurea*). *J. Exp. Bot.* **122**, 759–771.
- Mayak, S., and Halevy, A. H. (1980). Flower senescence. In "Senescence in Plants" (K. V. Thimann, ed.), pp. 131–156. CRC Press, Boca Raton, Florida.
- Molisch, H. (1938). "The Longevity of Plants" (H. Fulling, transl). Science Press, Lancaster, Pennsylvania.
- Mothes, K. (1964). The role of kinetin in plant regulation. In "Regulateurs Naturels de la Croissance Végétale" (J. P. Nitsch, ed.), pp. 131–140. CNRS, Paris.
- Murray, D. R., ed. (1984). "Seed Physiology." Academic Press, Orlando, Florida.
- Nicolas, G. (1918). Contribution a l'étude des variations de la respiration des végétaux avec l'âge. *Rev. Gen. Bot.* **30**, 209–225.
- Noble, R. D., Czarnota, C. D., and Cappy, J. J. (1977). Morphological and physiological characteristics of an achlorophyllous mutant soybean variety sustained to maturation via grafting. *Am. J. Bot.* **64**, 1042–1045.
- Noodén, L. D. (1980). Regulation of senescence. In "World Soybean Research Conference II: Proceedings" (F. T. Corbin, ed.), pp. 139–152. Westview Press, Boulder, Colorado.
- Noodén, L. D. (1984). Integration of soybean pod development and monocarpic senescence. *Physiol. Plant.* **62**, 273–284.
- Noodén, L. D., and Leopold, A. C. (1978). Phytohormones and the endogenous regulation of senescence and abscission. In "Phytohormones and Related Compounds: A Comprehensive Treatise" (D. S. Letham, P. B. Goodwin, and T. J. V. Higgins, eds.), Vol. 2, pp. 329–369. Elsevier/North-Holland, Amsterdam.
- Osborne, D. J. (1980). Senescence in seeds. In "Senescence in Plants" (K. V. Thimann, ed.), pp. 13–37. CRC Press, Boca Raton, Florida.
- Paranjothy, K., and Wareing, P. F. (1971). The effects of abscisic acid, kinetin and 5-fluorouracil on ribonucleic acid and protein synthesis in senescing radish leaf disks. *Planta* **99**, 112–119.
- Pech, J. C., and Romani, R. J. (1979). Senescence of pear *Pyrus communis* fruit cells cultured in a continuously renewed auxin-deprived medium. *Plant Physiol.* **63**, 814–817.
- Penning de Vries, F. W. T. (1975). The cost of maintenance processes in plant cells. *Ann. Bot.* **39**, 77–92.
- Person, C., Samborski, D. J., and Forsyth, F. R. (1957). Effect of benzimidazole on detached wheat leaves. *Nature (London)* **180**, 1294–1295.
- Peterson, L. W., and Huffaker, R. C. (1975). Loss of ribulose 1, 5 diphosphate carboxylase and increase in proteolytic activity during senescence of detached primary barley leaves. *Plant Physiol.* **55**, 1009–1015.
- Pierce, R. O., Knowles, P. F., and Phillips, D. A. (1984). Inheritance of delayed leaf senescence in soybean. *Crop Sci.* **24**, 515–517.
- Pjon, C. J. (1981). Effects of cycloheximide and light on leaf senescence in maize and hydrangea. *Plant Cell Physiol.* **22**, 847–854.
- Priestley, D. A. (1986). "Seed Aging." Comstock, Ithaca, New York.
- Priestley, D. A., and Posthumus, M. A. (1982). Extreme longevity of lotus seeds from Pulten. *Nature (London)* **299**, 148–149.
- Priestley, D. A., Cullinan, V. I., and Wolfe, J. (1985). Differences in seed longevity at the species level. *Plant Cell Environ.* **8**, 557–562.

- Pryor, W. A., ed. (1976). "Free Radicals in Biology," Vol. 1. Academic Press, New York.
- Rhodes, M. J. C. (1980). The maturation and ripening of fruits. In "Senescence in Plants" (K. V. Thimann, ed.), pp. 157–205. CRC Press, Boca Raton, Florida.
- Roberts, E. H. (1972). "Viability of Seeds." Chapman & Hall, London.
- Sabater, B., Rodriguez, M. T., and Zamorano, A. (1981). Effects and interactions of gibberellic acid and cytokinins on the retention of chlorophyll and phosphate in barley leaf segments. *Physiol. Plant* 51, 361–364.
- Sacher, J. A. (1957). Relationship between auxin and membrane-integrity in tissue senescence and abscission. *Science* 125, 1199–1200.
- Sanders, C. L. (1983). "Ionizing Radiation." Battelle, Columbus, Ohio.
- Sasaki, S., and Kozlowski, T. T. (1969). Utilization of seed reserves and currently produced photosynthesis by embryonic tissues of pine seedlings. *Ann. Bot.* 33, 473–482.
- Satler, S. O., and Thimann, K. V. (1983). Metabolism of oat leaves during senescence VII. The interaction of carbon dioxide and other atmospheric gases with light in controlling chlorophyll loss and senescence. *Plant Physiol.* 71, 67–70.
- Schumacher, W., and Matthaei, H. (1955). Über den Zusammenhang zwischen Streckungswachstum und Eiweiss-synthese. *Planta* 45, 213–216.
- Smith, D. L. (1981). Cotyledons of the Leguminosae. In "Advances in Legume Systematics," Part 2 (R. M. Polhill and P. H. Raven, eds.), pp. 927–940. Royal Botanic Gardens, Kew, England.
- Stoddart, J. L., and Thomas, H. (1982). Leaf senescence. *Encycl. Plant Physiol., New Ser.* 14A, 592–636.
- Suttle, J. C., and Kende, H. (1980). Ethylene action and loss of membrane integrity during petal senescence in *Tradescantia*. *Plant Physiol.* 65, 1067–1072.
- Takegami, T. (1975a). A study on senescence in tobacco leaf disks I. Inhibition by benzylaminopurine of decrease in protein level. *Plant Cell Physiol.* 16, 407–416.
- Takegami, T. (1975b). A study on senescence in tobacco leaf disks II. Chloroplast and cytoplasmic rRNAs. *Plant Cell Physiol.* 16, 417–425.
- Taylor, A. E., Matalon, S., and Ward, P., eds. (1986). "Physiology of Oxygen Radicals." Am. Physiol. Soc., Bethesda, Maryland.
- Tetley, R. M., and Thimann, K. V. (1974). The metabolism of oat leaves during senescence I. Respiration, carbohydrate metabolism, and the action of cytokinins. *Plant Physiol.* 54, 294–303.
- Thimann, K. V. (1980). The senescence of leaves. In "Senescence in Plants" (K. V. Thimann, ed.), pp. 85–115. CRC Press, Boca Raton, Florida.
- Thimann, K. V. (1987). Plant senescence: A proposed integration of the constituent processes. In "Plant Senescence: Its Biochemistry and Physiology" (W. W. Thomson, E. A. Nothnagel, and R. C. Huffaker, eds.), pp. 1–19. Am. Soc. Plant Physiol., Rockville, Maryland.
- Thimann, K. V., and Satler, S. O. (1979). Relation between leaf senescence and stomatal closure: Senescence in light. *Proc. Natl. Acad. Sci. U.S.A.* 76, 2295–2298.
- Thimann, K. V., Satler, S. O., and Trippi, V. (1982). Further extension of the syndrome of leaf senescence. In "Plant Growth Substances 1982" (P. F. Wareing, ed.), pp. 539–548. Academic Press, London.
- Thomas, H. (1975). Regulation of alanine aminotransferase in leaves of *Lolium temulentum* during senescence. *Z. Pflanzenphysiol.* 74, 208–218.
- Thomas, H. (1987). Sid: A Mendelian locus controlling thylakoid disassembly in senescing leaves of *Festuca pratensis*. *Theor. Appl. Genet.* 73, 551–555.
- Thomas, H., and Stoddart, J. L. (1975). Separation of chlorophyll degradation from other senescence processes in leaves of a mutant genotype of meadow fescue (*Festuca pratensis* L.). *Plant Physiol.* 56, 438–441.

- Thomas, H., and Stoddart, J. L. (1980). Leaf senescence. *Annu. Rev. Plant Physiol.* **31**, 83–111.
- Tilney-Bassett, R.A. E. (1986). "Plant Chimeras." Arnold, London.
- Tripathi, R. K., Vohra, K., and Schlosser, E. (1980). Effect of fungicides on plant physiology III. Mechanism of cytokinin-like antisenescence action of carbendazim on wheat leaves. *Z. Pflanzenkr. Pflanzenschutz* **87**, 631–639.
- Turgeon, R. (1984). Termination of nutrient import and development of vein loading capacity in albino tobacco leaves. *Plant Physiol.* **76**, 45–48.
- Villiers, T. A. (1973). Aging and the longevity of seeds. In "Seed Ecology" (W. Heydecker, ed.), pp. 265–288. Pennsylvania State Univ. Press, University Park.
- Von Abrams, G. J. (1974). An effect of ornithine on degradation of chlorophyll and protein in excised leaf tissue. *Z. Pflanzenphysiol.* **72**, 410–421.
- Wollgiehn, R. (1967). Nucleic acid and protein metabolism of excised leaves. *Symp. Soc. Exp. Biol.* **21**, 231–246.
- Wollgiehn, R., and Parthier, B. (1964). Der Einfluss des Kinetins auf den RNS-und Protein-Stoffwechsel in abgeschnittenen mit Hemmstoffen behandelten Tabakblättern. *Phytochemistry* **3**, 241–248.
- Wood, J. G., and Cruickshank, D. H. (1944). The metabolism of starving leaves. 5. Changes in amounts of some amino acids during starvation of grass leaves; and their bearing on the nature of the relationship between proteins and amino acids. *Aust. J. Exp. Biol. Med. Sci.* **22**, 111–123.
- Wood, L. J., Murray, B. J., Okatan, Y., and Noodén, L. D. (1986). Effect of petiole phloem disruption on starch and mineral distribution in senescing soybean leaves. *Am. J. Bot.* **73**, 1377–1383.
- Woolhouse, H. (1982). Biochemical and molecular aspects of plant senescence. In "Molecular Biology of Plant Development" (H. Smith and D. Grierson, eds.), pp. 256–287. Blackwell, Oxford.
- Woolhouse, H. (1983). Leaf senescence. In "Post Harvest Physiology and Crop Preservation" (M. Lieberman, ed.), pp. 256–281. Plenum, New York.
- Yoshida, Y. (1961). Nuclear control of chloroplast activity in *Elodea* leaf cells. *Protoplasma* **54**, 476–492.
- Yoshida, Y. (1974). The role of the cell nucleus in relation to the senescence of chloroplasts in detached *Elodea* leaves. *Symp. Cell Biol.* **25**, 131–140.
- Yu, S. M., and Kao, C. H. (1981). Retardation of leaf senescence by inhibitors of RNA and protein synthesis. *Physiol. Plant.* **52**, 207–210.

NOTE ADDED IN PROOF. These data come primarily from disruptive procedures, especially selective inhibitors. While these procedures are subject to some caveats, they, particularly the inhibitors, have been very useful in analyzing photosynthesis and other biological processes. No doubt, they will also help in studying senescence, but they must eventually be supported by other lines of evidence.